UNIVERSITY OF CALIFORNIA
COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION

CIRCULAR No. 276
March, 1924

HOME CANNING

By W. V. CRUESS and A. W. CHRISTIE

CONTENTS

FOREWORD

This circular is based on Circular No. 158, "Home and Farm Canning," but has been rearranged and almost completely rewritten. By omitting matters of interest only to small canneries, and, by introducing new and improved methods specially adapted to the home, it has been made more suitable for its primary purpose. The writers desire to express their appreciation to Professor F. T. Bioletti, Dr. K. F. Meyer, Dr. W. A. Magoon, Mr. A. Richardson, and others for valuable suggestions given during the preparation and revision of the manuscript.

A. PRINCIPLES OF CANNING

Requests for information on the home canning of fruits and vegetables are received at the station with increasing frequency. To supply this information it has been found necessary to test the various methods generally recommended. This has been done both with the utensils used in most kitchens and with special canning equipment constructed for home and small-scale operations. This circular is intended to describe approved methods and also to give general information asked for by numerous inquirers.

A large quantity of fruits and vegetables goes to waste every year or is sold at prices which return little profit. Much of this, while unsuited to the special requirements of the commercial cannery, is well adapted to canning for home use. The quality may be as good as that of the products of commercial canneries or better if put up with the proper knowledge and care. It is often possible to find a limited market for home products of this kind at profitable prices.

Local and private markets are usually the most satisfactory for the home or farm canner. He will seldom find it profitable to sell on the general market through dealers in competition with commercial canneries. With careful attention to all the details of the work and a little business ability it will often be possible to make the home canning outfit a profitable adjunct to the orchard and garden, and much of the work will be found agreeable and profitable by the women of the household.

Causes of Spoiling.—The principal aim of canning is to prevent spoiling. Spoiling is not due directly to the action of air or of heat and it is not simply a chemical nor a physical change. When vegetable materials ferment, decay or turn sour, it is because of the growth of certain microscopic, living organisms, or "germs." These all

belong to the vegetable kingdom and are divided into three groups: molds, yeasts, and bacteria. Familiar examples of each group are the blue-green mold of spoiled fruits, the yeast used in bread-making, and the bacteria of the scum or "mother" of vinegar. What we see in compressed yeast, for instance, is simply a mass consisting of millions of germs. Individual germs are too minute to be seen without a microscope. Their activities cause the molding of jellies, the swelling and souring of canned fruits and vegetables, and the putrefying of meats. The character of the material largely determines which type of spoiling will occur. Acidity is favorable to yeasts and molds. Fruits may therefore spoil by yeast fermentation or become moldy. Bacteria prefer a medium with little or no acid. When vegetables or meats decay it is therefore usually due to the action of bacteria. Neither fruits nor acid vegetables are favorable to the growth of the bacteria which cause the putrefaction of meats.

Methods of Preserving.—The micro-organisms ("germs") which cause spoiling come from the air or from the surfaces with which the material comes in contact. They can no more develop from non-living matter than wheat can appear spontaneously in soil devoid of wheat seed. In food preservation, we are dealing with living organisms, whose activities can be prevented in one of two ways: We may kill all the germs present by heat or other means and prevent the entrance of all others, or we may make the conditions so unfavorable to the germs that they cannot grow or do any damage. The latter way is followed when we impregnate meat with so much salt that bacteria cannot grow, or add so much sugar to jam that yeast cannot multiply. The heat method is utilized in most methods of canning.

Sterilization by Heat.—The killing of all germs present is called sterilization. In canning, this is accomplished by heating. The material to be preserved is placed in a jar or can, in which it is sealed hermetically, i.e., made air-tight. It is then heated to a temperature fatal to all the germs it contains. No spoiling can then take place until the vessel is opened, as there are no means by which germs can enter.

Molds and yeasts, as they occur on fruits and vegetables, are quickly killed at temperatures below 212° F., the boiling point of water. In most cases, in fact, they are killed at temperatures between 150° F. and 180° F. On the other hand, bacteria occurring on vegetables are much harder to kill, many of them withstanding the temperature of boiling water for several hours. These bacteria owe their astonishing resistance to the presence of spores. Spores are to bacteria what seeds are to higher plants and are resistant to heat.

These bacteria, with resistant spores, probably occur also on fruits, but it is usually not necessary to kill them in this case, as they are very sensitive to acidity and therefore cannot grow in fruit juices. With vegetables the case is different. These, with the exception of tomatoes, have little or no acidity and are well suited to the growth of the heat-resistant bacteria. To sterilize vegetables it is therefore usual to heat the sealed cans to temperatures above 212° F. The temperature can be raised to 212° F. by placing the sealed cans in an open tank or pot containing boiling water. But under these conditions no higher temperature can be reached, as the evolving steam removes the excess of heat as fast as it is applied. In a closed space where the steam cannot escape, however, higher temperatures can be obtained. As the temperature rises the pressure increases. In canning vegetables, pressures of five to fifteen pounds to the square inch are generally used. This corresponds to temperatures of approximately 227° F. to 249° F.; the higher the pressure the higher the temperature.

Sterilizing Fruit Juices.—Heating fruit juices to 212° F. always changes the flavor more or less. In a few cases, this change of flavor may be an improvement, but in most cases it is desirable to retain as much of the original character of the juice as possible. This is accomplished by careful handling and by heating to the lowest temperature that will insure sterilization. Experiments continued for two years at the Fruit Products Laboratory have shown that most juices can be safely sterilized at temperatures of from 165° to 175° F. See Circular 220, Unfermented Fruit Juices, for details of preparation.

Preservatives.—Food materials can be prevented from spoiling by the use of certain substances known as preservatives. Some of these are injurious to health and forbidden by the pure food laws. Others are not encouraged by the pure food laws, because they are used by unscrupulous manufacturers to disguise defective materials or careless methods of manufacture. The use in canning of such preservatives as benzoate of soda, salicylic acid, sodium fluorid, boric acid, etc., is condemned.

Certain preservatives, however, are useful and permissible. For fruits, sugar is the preservative most commonly used. If the sugar content of fruit juice, jelly or jam is raised to 65 per cent by evaporating part of the water, or by adding sugar, these products become unsuitable to the growth of microörganisms and will keep even in open vessels. This is why dried fruit does not spoil and why jam must be made very sweet.

For some products salt is extensively used, as in preserving olives in barrels and in keeping certain types of pickles. Vinegar and spices are used in the same way. Sometimes a combination of the effects of heat sterilization and harmless preservatives such as vinegar is used in the preserving of pickles, etc.

METHODS OF HOME CANNING

The principles and theory of canning are the same whatever the scale on which it is done. The differences are only in the mechanical details of the methods of applying these principles.

There are two general methods in use. In one, known as the "Hot-pack method," the material is cooked in open pots and poured into the cans while hot, together with the hot brine or syrup. The cans are sealed immediately, and may or may not be sterilized. In the other, the "Cold-pack method," the freshly prepared material is placed cold in the cans and then covered with the hot syrup or brine, sealed and sterilized. With both methods the material is always hot when the cans are sealed. The cold-pack method is generally the best for vegetables, while the hot-pack method can often be used to advantage with fruits, if supplemented by sterilization in the container.

B. METHODS, MATERIALS, AND EQUIPMENT

General Equipment.—Most of the utensils and materials needed in home-canning are to be found in all kitchens. They include a good stove, or other means of heating, a table for the preparation of materials, a sink and good supply of water, various agateware or aluminum pots, saucepans, and buckets, large cooking spoons and a sufficient supply of sugar and salt. To these should be added a good thermometer, suitable for placing in liquids and reading to at least 250° F. (cost, about $1.50). A Balling or Brix saccharometer or sugar tester is also very useful where fruit is to be canned on a farm scale. It should read from 0 to 70 per cent and costs about 75 cents. For use with this will be needed a tin cylinder to hold the liquids to be tested. It should be about 1½ inches in diameter and about 12 inches long (fig. 9). The thermometer and saccharometer can often be obtained through a drug store or the local dealer.

Other necessary or desirable materials are described in the following paragraphs. If the canning is to be done on a somewhat larger scale for the market it will often be advisable to purchase a factory-made outfit which may be obtained in various sizes.

Jars.—Glass jars are preferable to tin cans for home canning of fruits because they can be used repeatedly. Their greater initial cost is offset by this advantage. Where the product is to be sold, it is usually necessary to use cans unless unusually high quality is demanded and a price sufficient to cover the extra cost of jars can be obtained.

a *b* *c* *d* *e*

Fig. 1.—Types of jars used in home canning: (*a*) Removable clamp and glass top; (*b*) fixed clamp and removable glass top; (*c*) lacquered metal clamp top; (*d*) wide mouth and screw top of lacquered metal; (*e*) ordinary narrow mouth and screw top, porcelain or glass-lined.

Glass jars are to be found in a variety of sizes and shapes and with various methods of hermetic sealing. The sizes most used are pints and quarts and to a smaller extent half-gallons. The only important variation in shape is the width of the mouth which may be as wide as the jar or only about half its width. The commonest method of sealing is by means of a rubber ring which fits between the cover and the top of the jar (see fig. 1).

In the Mason jar and its various modifications the cover is a screw cap which makes a hermetic joint when screwed down on the rubber ring. In the ordinary form this cap is of zinc with a porcelain lining. This is the commonest and cheapest form. Aluminum and heavily lacquered metal caps are to be preferred to zinc caps because of the tendency of the zinc to corrode with sour fruits and tomatoes. Wide-mouth Mason jars are now made which are very convenient for large fruits. However, their large enameled metal caps are often difficult to remove and may be broken in opening the jar.

In another common form, of which the Atlas "E–Z" seal jar is an example, the cover is a glass disc held in place and pressed down on the rubber by means of a strong wire clamp. After the fruit

cools the clamp may be removed and the cover will be held in place by the vacuum. This affords a convenient means of detecting spoiled jars. If there is any fermentation of the fruit, the gas formed will fill the vacuum and the cap will be loosened. This is a very convenient and durable form of cover and there are no metal parts in contact with the fruit.

Vacuum sealed glass jars are used in jelly and preserve factories. They have enameled metal caps resting on heavy, soft rubber rings and are held in place by a vacuum inside the jars. This vacuum is produced by means of an expensive machine. For home use some forms of these jars may be sealed by forcing the caps on by hand, while the contents are hot. On cooling, a vacuum is produced which holds the caps firmly in place.

In all cases where poor rubbers are used in sealing they must be specially treated, as they will otherwise give a disagreeable taste to the food. Fruit and vegetables are sometimes completely spoiled by this taste. It can be avoided by thoroughly boiling the rubbers in water made alkaline with two or three teaspoons of washing soda to the quart. They are then rinsed and boiled a second time in water made slightly acid with lemon juice or vinegar. A third short boiling in plain water fits them for use. There are now several good brands of jar rubbers which do not require this treatment. They can be placed directly on the jars from the package.

In some forms of jars, the rubber ring is replaced by a ring or disc of pasteboard treated or varnished. These are not commonly used and are less generally suitable.

A commoner type that avoids the use of rubbers is the Economy jar and its modifications. The cover is an enameled metal disc around the edge of which runs a small groove filled with a hard wax-like compound. When the jar and its contents are heated this compound melts and seals the cover to the jar when it cools and hardens. A metal spring holds the cover in place until the compound hardens and may then be removed. This is jar "*c*" in figure 1. Considerable difficulty has been met in using this jar because of failure of the caps to seal the jars perfectly.

Cans.—There are three general types of cans used for fruit and vegetables—the "wax-top," the "solder-top," and the "sanitary."

The cover of the "wax-top" can is sealed on by means of a ring of hot sealing wax. It is suitable for use with fruits and tomatoes, but it is not satisfactory for vegetables which require high temperatures. The cans are easily manipulated and require no special equipment.

"Solder-top" or "stud-hole" cans with the necessary soldering tools are used in the factory-made home canning outfits and can be used with any outfit. The top of the can has a circular opening varying in width with the size and type of cans. After filling the can, this opening is closed by soldering on a tin disc. This disc is usually perforated with a small hole to allow steam to escape during the preliminary heating. This hole must be closed with solder before the final sterilization. (See fig. 2, *G*.)

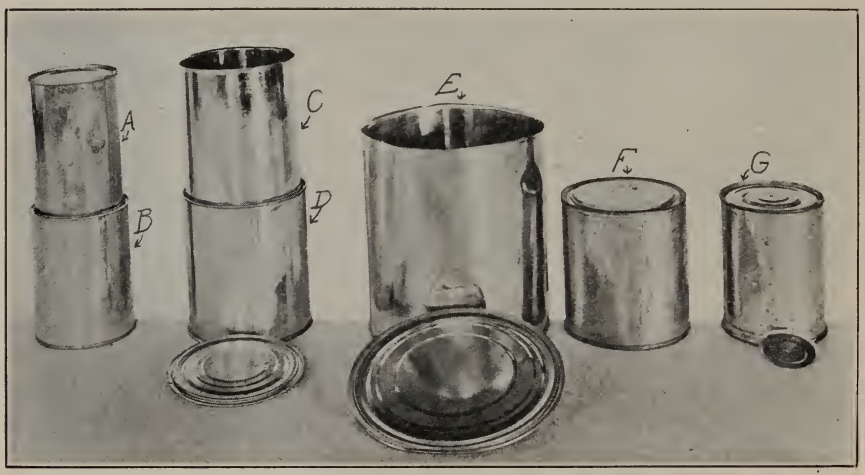

Fig. 2.—Types of cans used in home canning: (*A*) No. 1 tall "sanitary can;" (*B*) No. 2 sanitary can; (*C*) No. 2½ sanitary can; (*D*) No. 3 sanitary can; (*E*) No. 10 sanitary can; (*F*) quart size wax top can; (G) No. 2 solder top can.

"Sanitary cans" used in large canneries are not sealed with solder. The cover or cap is "crimped" on by means of a special machine. There is a rubber coating or paper gasket on the cap where it comes in contact with the can, which makes the sealing doubly sure. Very satisfactory hand-power machines can be obtained at moderate cost.

Cans may be obtained which are coated inside with a protective enamel. These are suitable for red fruits, berries and beets as they minimize bleaching of the red color through action of the tin.

Cans versus Jars.—It is recommended that vegetables, except tomatoes and rhubarb, be sterilized under steam pressure because of the danger of food poisoning from those heated only at 212° F. (in steam or boiling water). Unfortunately, glass jars are unsatisfactory for use in a pressure sterilizer, because much of the liquid (brine or syrup) boils out of the container, causing the jar after sterilization to be only three-quarters or one-half filled with liquid. If the jars are

tightly sealed to avoid this difficulty, many of them will burst or many of the rubbers will be forced away from the top, causing the jar to leak. These difficulties are overcome in commercial canneries by the use of compressed air in the pressure cookers, but this is not feasible in the home.

Fig. 3.—Small hand power sealing machine for sanitary cans.

We have found that sanitary cans are the only satisfactory containers for vegetables to be sterilized under pressure in the home. Where the quantity of vegetables is too small to warrant purchase of a can sealer, it is possible for several families to join in the purchase and use of such a machine. The cost is approximately $20.00.

Sealing Sanitary* Cans.—Sanitary cans are more satisfactory for home use than solder top cans for several reasons. Very little experience is required to obtain a perfect seal with the hand power sealers used for sanitary cans. The opening of the can is wide, permitting packing of large pieces of fruit or vegetables. The cans are readily obtainable from can manufacturers, whereas solder top cans are now difficult to obtain. There is no danger of fire or explosions in sealing sanitary cans because the gasoline blow torch used in heating soldering steels is not used.

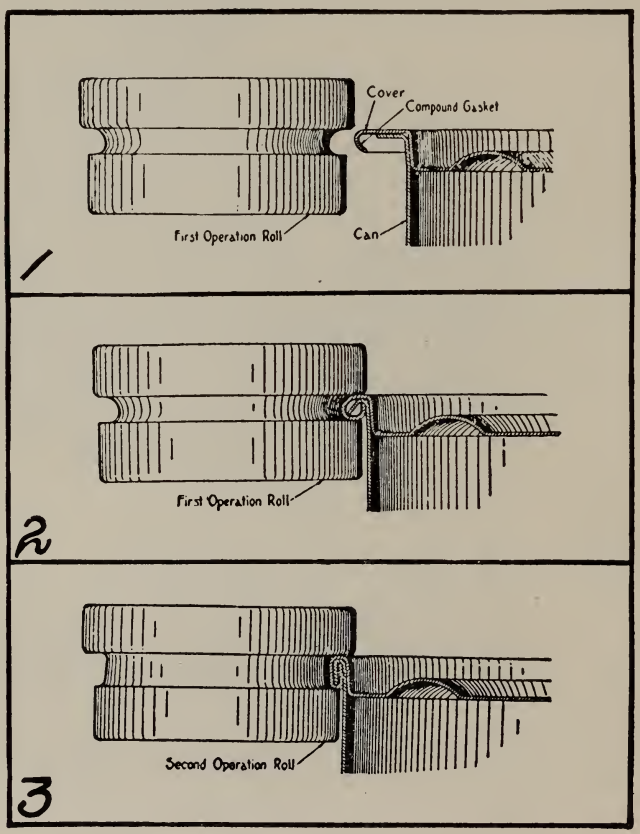

Fig. 4.—Sealing a sanitary can. (After Cruess and Christie Laboratory Manual of Fruit and Vegetable Products.)

1. Lid in place before sealing.
2. Appearance of lid and edge of can after first operation.
3. Appearance after second operation.

*"Sanitary" is a trade name and when applied to this type of can does not imply that other cans are unsanitary.

In using sanitary cans in home canning the prepared food is packed into the washed can and boiling hot syrup or brine is added to fill it. In commercial canning the can and contents are heated in live steam or hot water for 4 to 10 minutes before sealing in order to expel air from the food and liquid. While such preliminary heating is desirable it is not essential in home canning, provided the can is filled with *boiling hot* sprup or brine and sealed *at once.*

The general appearance and method of using a hand power sanitary can sealer are shown in fig. 3. To use the sealer proceed as follows:

(*a*) Clamp the sealer to a stout table top as shown in fig. 3. Place the lid on the can and set the can on the turn table. Raise the turn table by swinging the elevating lever from the operator until it will go no farther.

(*b*) Turn the crank rapidly and at the same time push the seaming roll lever very slowly *away from the operator* to bring the roll number one against the top of the can until it will go no farther. Fifteen turns of the crank should be sufficient.

(*c*) Continue turning the crank rapidly and pull the seaming roll lever slowly *toward the operator* until it will go no farther. Give the crank several more turns and remove the sealed can.

Fig. 4 illustrates the top of the can before sealing, after the first seaming operation and after the final operation. Sealing a sanitary can is spoken of as "double seaming."

Solder top cans are difficult to obtain at present and require considerable skill in sealing. They are not recommended for home use.

PREPARATION OF MATERIALS

Nearly all fruits and vegetables require some kind of preparatory treatment before canning. This may be washing, sizing, sorting for color or ripeness, peeling, pitting, coring or slicing. In some cases special machines or tools are necessary. Some simple tools generally useful are shown in figure 5. These are (*A*) a knife fitted with a guard to prevent excessive waste of pulp in peeling, and a broad knife (*B*) for cutting and slicing. For cling-stone peaches a special spoon (*C*) with sharp edges is used. A curved spoon or knife (*D*) is used for removing the cores of halved pears. Knife (*E*) is used for coring apples. A cherry pitter is very useful. See figure 8. Slicing and cubing machines are available for vegetables.

The Raw Materials.—With the exception of pears, fruits for canning are best if tree ripened and canned as promptly after picking as possible. Fruit purchased in the markets of large cities is usually picked immature. It, therefore, is of poorer flavor than that which is tree ripened, often lacks sugar, and may be more or less wilted or overripe. City housewives will rarely find such fruit either economical in price or equal to freshly picked ripe fruit in quality.

Fig. 5.—Knives used in canning: (*A*) peeling knife; (*B*) cutting knife; (*C*) peach pitting spoon; (*D*) pear coring knife; (*E*) apple coring knife.

Vegetables as purchased in city markets are usually too costly for home canning; commercially canned vegetables are much cheaper. Vegetables from city markets are apt also to be wilted or tough because of standing after harvesting. Experience and experiments have proven that such material is more difficult to sterilize than the freshly picked products, because of contamination with resistant bacterial spores, and therefore more liable to cause food poisoning when under-

sterilized. Only freshly gathered vegetables from the home or farm garden should be used for home canning; for reasons of quality, economy, and safety.

Preparation of Fruits.—General directions applicable to more than one variety of fruit may most conveniently be given at this point.

Sorting and Grading.—Moldy and soured fruit should be discarded —it is not only unfit for food but is more liable to develop botulinus poison if improperly sterilized.

Overripe but sound fruit should be used for jam rather than for canning.

If the canned product is to be sold, it should be carefully graded for size, color, and maturity into two or three grades. These may be designated First Quality (finest and most nearly perfect specimens), Standard Quality (sound fruit of fair quality), and Pie Fruit (small, slightly blemished, or overripe fruit).

Washing.—Clean fruit is essential to success. Wash all fruit thoroughly before canning.

Hand Peeling.—If only small lots of fruit are to be canned, hand peeling is the most practical method. A guarded knife such as that shown in figure 5–A is desirable for soft fruits such as peaches and pears, while the knife shown in figure 5–E is perhaps most satisfactory for peeling and coring apples.

Mechanical Peeling.—If a relatively large quantity of apples is to be canned, some form of mechanical peeler is desirable. Hardware stores can supply an inexpensive hand power peeler for kitchen use. A more expensive type peels and cores, or peels, cores, and slices the apple in one operation. This is very useful for preparing apples for drying.

Mechanical peelers for other fruits are not very satisfactory.

Lye Peeling.—To lye peel peaches or apricots, first prepare in an agate ware or iron kettle (never aluminum) a lye solution of ¼ pound (4 ounces or about 4 level tablespoons) of granulated lye, such as Red Seal or Rex brands, in 2 gallons of water. Heat to boiling, and while actively boiling immerse the peaches (halved clings or whole freestones) or whole apricots in a wire basket in the boiling solution until the skin is loosened and partially dissolved. This will usually require 30 to 60 seconds. Remove. Wash in water until skin and lye are removed. Rinse thoroughly in fresh water. Washing away the skin and lye under a jet of water from a faucet is much more effective and satisfactory than washing in still water.

It will not be found worth while to attempt to lye peel small lots of fruit, but the method will save a great deal of time if 50 pounds of fruit or more is to be peeled. Lye peeled fruit should be canned at once to avoid undue darkening.

Coring and Pitting.—Pears are peeled, cut in half, and the core is then removed by the knife shown in figure 5–D or by means of a sharp teaspoon.

Dessert cherries are usually canned without pitting, but sour or sweet cherries intended for use in pies should be pitted before canning. A mechanical pitter, such as that shown in figure 8, is more convenient than the small pitters operated by the thumb and two fingers.

Cling peaches are difficult to pit unless the spoon shown in figure 5–C is used. To use this spoon, first cut the peach to the pit completely around the suture ("crease"). Insert the pitting knife (also known as pitting spoon) from the stem end of the peach until the point of the spoon rests at the blossom end of the pit. Rotate the knife until one half of the peach separates. Then scoop the pit from the other half. Pitting is best done before peeling.

Freestone peaches and apricots need only be cut in half and the pit removed with the point of the cutting knife.

Peeling Vegetables.—Tomatoes are readily peeled after immersion in boiling water for about one minute and chilling in cold water. The cores should be removed at the same time, but if possible without opening the seed sacs.

Beets require about 10 to 15 minutes boiling to loosen the skin; sweet potatoes require a longer time. Other root vegetables are peeled by hand without preliminary heating.

Mechanical peelers for vegetables are too costly for home use.

Packing Fruit.—Most fruits may be packed into jars or cans after preparation and without previous blanching or cooking. They should be arranged to present a neat appearance in the jars.

Some fruits soften during sterilizing and give partially filled containers, unless partially cooked before packing. Berries for this reason should be cooked with an equal weight of sugar before packing. This is best done by adding the dry sugar to the fruit in a preserving kettle, bringing to a boil and boiling gently 3–4 minutes. The juice of the fruit forms a syrup with the sugar—usually an excess of syrup unless the mixture be allowed to stand overnight to permit absorption of the syrup by the fruit. It may then be packed and sterilized in the jars or cans.

Apples should be cooked in boiling water and apricots in boiling dilute syrup 3–4 minutes to soften them and cause shrinkage. They may then be packed hot. If this is not done, the jars will be only partially full after sterilization.

All fruits, in order to conserve can and jar space, may be cooked a short time with sugar and a small amount of water as shown in figure 9. Some home canners prefer this to the cold pack method. The objection to it is that some fruits become broken and present a less attractive appearance than cold packed fruit.

Cold packing of the raw fruit is recommended for peaches, pears, plums, prunes, and cherries.

Blanching.—Certain vegetables should be "blanched" or parboiled before canning. This is done by dipping them in boiling water or heating in steam. A wire screen basket or a frying basket, such as is used in cooking doughnuts, will serve to hold the vegetables while they are dipped in a large cooking pot containing boiling water. This treatment improves the quality, by removing slimy matters and lessening the astringent taste of the skins. It is necessary with asparagus to remove bitterness. Blanching also softens the vegetables so that a larger amount may be packed into the jar or can.

Apples and apricots should also be blanched as described above in order that a full can may be obtained.

Exhausting.—This process is desirable with nearly all air-tight containers which are to be sterilized by heat. It consists of a preliminary heating before sealing and before the final sterilization. It results in expanding the air inside the container and thus driving out most of it. When the sealed container and its contents cool, the small amount of air still enclosed contracts and produces a partial vacuum. If cans are sealed while the contents are cool they will swell on heating, owing to the expansion of the heated air. Exhausting is not necessary with jars. If cans are packed with hot products, boiling hot syrup or brine added and the cans sealed at once, exhausting can be omitted in home canning. If merely warm or cold brine or syrup is added, the can and contents should be heated in live steam or boiling water for at least five minutes before sealing.

Syrups.—Fruits are canned in sugar syrups of various strengths or concentrations. In general, the more acid fruits require the most sugar. The appropriate strengths are given in the directions for canning the various fruits.

Brix or Balling Sugar Testers.—Syrups of the desired strengths may be made up by weighing the sugar and measuring the water, or by adding sugar to the water until the desired strength is indicated

by the sugar tester or hydrometer. This is sometimes called a saccharometer and the commonest forms are the Brix and the Balling. The hydrometer is floated in a sample of the syrup contained in a tall, narrow metal or glass cylinder and the per cent of sugar read from the scale at the surface of the liquid. If the syrup is cold the reading is correct enough for the purpose, but if very hot the reading may be several per cent too high. (See fig. 6.)

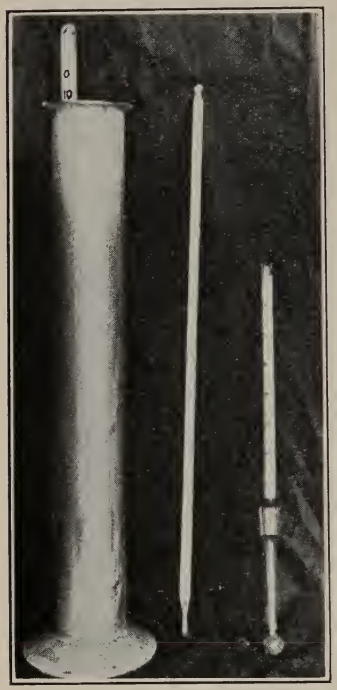

Fig. 6.—Cylinder, thermometer, and Balling sugar tester. The tester in the cylinder of syrup is read at the surface of the liquid. In the illustration this is approximately 12 per cent.

Baumé Sugar Tester.—This is a hydrometer similar in form to the Brix, differing only in the scale, which reads in degrees instead of per cent. The degrees may be multiplied by two to give the per cent approximately.

Strength of Syrups.—For all practical purposes syrups for home canning may be prepared with the following proportions of sugar and water: Light Syrup, 1 cup sugar to 4 cups of water; Medium, 1 cup of sugar to two of water; and Heavy, 1½ cups of sugar to 1 of water.

By carefully measuring the sugar and water, syrups of any desired strength can be made. The following table shows the relation between the sugar per cent, Brix or Balling, the Baumé degree and the proportion of sugar and water:

SUGAR SYRUPS

Per cent of sugar (Brix or Balling)	Baumé degrees	Weight of sugar added to 1 gal. of water
10	5.5	0 lbs. 15 oz.
20	11.0	2 2
30	16.5	3 10
40	22.0	5 10
50	27.0	8 6
60	32.5	12 10
65	35.0	15 11

In making syrups according to this table, the weight of sugar in the last two columns opposite the desired per cent or degree is added to each gallon of water and dissolved by warming and stirring. The volume of syrup obtained is greater than that of the water used. The increase of volume is very slight with syrups of 5 to 15 per cent, but is greater with more concentrated syrups; 15 pounds 11 ounces of sugar and 1 gallon of water giving nearly 2 gallons of syrup at 65 per cent. For one quart of water use one-fourth the amounts of sugar noted above.

Cane and Beet Sugar.—In numerous tests made by the Fruit Products Laboratory, beet sugar was found to give results equal to those of cane sugar. The prejudice against beet sugar is no longer warranted as it is now produced in as pure a state as cane sugar, with which it is identical chemically. Beet sugar is equally as good as cane sugar for jellies and preserves and is used by many canners and preservers.

Adding the Syrup.—The syrup should be boiled, strained to remove solid impurities and poured into the jar or can boiling hot.

Brines.—For most canned vegetables a brine of about 2 per cent salt is used. This corresponds to about 2½ ounces or about 5 level tablespoons of salt per gallon of water. Unless otherwise directed, this brine, boiling hot, should be used to fill all cans of vegetables.

Sterilizers.—A sterilizer is a vessel in which the filled cans or jars are heated to the degree and for the time necessary to sterilize their contents.

Sterilizer for 212° F.—The sterilizer containing the cans and several inches of water is placed on a stove, and steam generated by boiling the water heats the cans. The cover must be sufficiently close to insure steam heat in all parts of the vessel, but must not be too tight, or the steam pressure will cause the vessel to burst. An ordinary wash boiler fitting the top of a kitchen stove can be made to serve as a very satisfactory home sterilizer. A piece of heavy wire screen of half-inch mesh or a wooden rack cut to fit should be placed in the bottom. This will serve to keep the jars from contact with the bottom of the boiler, where they might break if too close to the fire. Inexpensive jar racks to be used in wash boiler sterilizers are now obtainable at any hardware store. Such a rack is shown in figure 9.

Cans may be placed in two or more tiers, separated and supported by slat gratings which allow the steam to penetrate to all parts of every can. The cover of the boiler should fit snugly in order that the steam will be confined and heat the upper part of the sterilizer

to the boiling temperature. A cloth should be placed between the cover and the top of the boiler if the cover does not fit tightly. See figure 10.

Count time after the water boils.

Pressure Sterilizers.—Certain vegetables are difficult to sterilize except at very high temperatures. Sterilizers using high pressure steam will attain these temperatures and the cheapest forms can be bought for about $18. See figure 11.

Where vegetables and meat are to be canned for sale it will usually pay to obtain a pressure cooker, as they are fairly easy to operate. Directions for operating accompany the outfits.

The pressure cooker is fitted with steam gauge, thermometer, release cock and safety valve with weight and lever to regulate the pressure. In using it about 3 inches of hot water is added. The sealed cans are then placed in the crate and lowered into the sterilizer. The cover of the cooker is now screwed down, but the *release cock is left open.* Heat is then applied until steam escapes freely from the open cock. This cock is then closed and heating continued until the temperature reaches the desired point. At this point the safety valve, weight and lever should be set for the corresponding pressure. At the same time the release cock is opened slightly, so as to allow a small escape of excess steam. By this means the temperature can be regulated very exactly. The safety valve will open and relieve the pressure if the temperature commences to go too high. When the heating has continued for the required time, the cooker is removed from the fire, the release cock opened full, and when the pressure has fallen to 0 the cans are removed and cooled in water. If the cooker is opened before the pressure has fallen to 0, steam may scald the operator. The larger outfits of this kind are equipped with a small steam boiler for heating, and three or more cookers. Pressure sterilizers are usually operated at 5, 10, or 15 pounds pressure, corresponding to 227° F., 239° F., and 249° F., respectively.

Closing and Cooling Jars and Cans.—After the sterilizing period is completed in the 212° F. sterilizer or after the pressure in the pressure cooker has fallen to 0, with the release valve *closed,* remove the jars; screw or clamp the tops tightly and invert jars to cool in a room free from cold drafts. The exceptions to this rule are Economy and similar jars with composition tops—clamp the tops of these tightly but do not invert.

Cans are sealed before sterilization; and are removed and chilled to about blood temperature in cold water after sterilization. With

cans the release valve may be opened immediately after the sterilization period is complete.

Marking Cans and Jars.—All containers should be plainly marked with the variety and grade of the product. This can be done by means of a small set of rubber stamps and canner's ink, which will stand hot water. They may also be marked after sterilization with gummed labels or wax pencils specially made for writing on tin and glass. The name of the fruit and some such mark as A or 1 for first and B or 2 for second grade on the bottom of the can will serve to identify them. India ink is satisfactory for stamping or marking cans.

All lots should be dated so that the containers of each lot may be identified later, and a short record giving the time of sterilization in each case should be kept for future reference. Such labeling and records will be found very valuable in locating the cause of spoilage, should this occur.

Storage and Spoilage.—Before any canned fruit is put on the market, it should be stored at least a month to see if it will show spoilage. It is better to have cans spoil in the storeroom than on the grocers' shelves. If the fire used to heat the sterilizer is not hot enough, it may take too long to bring the cans to the temperature of boiling water and the "germs" that cause spoilage may not be killed. Often, however, the trouble is due to leaks in the cans. With an inexperienced operator, leaks often occur around the seam of sanitary cans or in the solder groove of the cap of solder top cans. When the capping operation is well done, there should be very few leaks. Leaks can be detected by bubbles appearing when the cans are dropped into hot water. Leaks permit air to enter and the air brings with it "germs" which cause the fruit or other product to ferment or spoil and produce the gas that causes the cans to swell. Jars should be wrapped in paper to exclude light and stored in a cool place.

Spoiled cans or jars of food should never be tasted or used. They may contain *Bacillus botulinus,* and be deadly poisonous. Do not feed spoiled canned food to fowls or animals—it may poison them. Many cases of poisoning of chickens by spoiled home canned foods are on record. See also discussion of Ptomain and Botulinus poisoning, page 34.

C. SPECIAL DIRECTIONS FOR FRUITS

Apples.—Canned apples are used principally for pies. Any variety will do for this purpose, but canners in California are limited largely to Bellflowers, Newtown Pippins, and Gravensteins, as these are the chief varieties grown in the state and available culls are chiefly of these varieties.

Peel; core; quarter; blanch in boiling water 3–4 minutes; pack hot; fill with boiling water, and process as directed in Table 1.

Apple Sauce.—Prepare as for the table. Pack scalding hot into cans. Sterilize as for apples.

Pears.—The Bartlett is the best variety for canning purposes. Fruit for canning is harvested while still green but after it has reached full size. It is allowed to ripen in boxes. When canned, it should be of good size and prime ripe, but not too soft. The fruit is peeled by hand and cored by the coring knife shown in figure 5–D.

As pears tend to turn brown rapidly after peeling, they should be placed in the can with syrup as soon as peeled, or should be kept under water or dilue brine (2 tablespoons of salt per gallon of water) after peeling until used. Pack into jars or cans and add hot medium or light syrup. See Table 1 for sterilization.

Peaches.—For canning, peaches must have a good flavor which remains after heating; the texture must be close and the fiber tender; the color should be an even yellow and the ripening uniform from surface to pit. Of the cling varieties, the Tuscan and Phillips are very satisfactory, and of the freestones, the Lovell, Muir, Crawford, and Elberta are preferred.

Peel and pit as directed on page 11. Pack in cans or jars and add hot Medium or Heavy syrup. See also table 1 for further directions.

Peaches may be canned in a plain syrup or in a sweet spiced vinegar made as follows:

Sugar	3½ lbs
Vinegar	1 pint
Water	1 pint
Ginger root	¼ oz.
Whole cloves	½ oz.
Stick cinnamon	½ oz.

Bring this mixture to boiling. Let stand over night to absorb spice flavor. Strain and add boiling hot to the jar or can.

If full jars or cans are desired the fruit may be prepared and canned as directed in the hot-pack method shown in figs. 9 and 10.

Apricots.—Apricots for canning should be ripe and well colored, but not too soft. Many canners make the mistake of canning apricots too green. The canned product from such fruit has a "green" astringent taste that no amount of sugar can wholly overcome. If over-ripe, on the other hand, the fruit cooks down to a jam of unattractive appearance. Blanching for 3–4 minutes in boiling syrup before packing is desirable.

Apricots require a heavy syrup to bring out their best flavor. See table 1 for further directions.

Fig. 7.—Funnel for filling fruit and syrup into jars.

Plums.—This fruit is canned whole. On account of the plum's high acidity, glass is to be preferred to tin.

The fruit should be picked when it is beginning to turn soft. If too ripe, it will cook down to a jam in the can and if too green will be too sour and lacking in flavor. Blanching, as with apricots, before canning is desirable. Pack in cans or jars and add a Medium or Heavy syrup. See also table 1 for sterilization.

Fresh Prunes.—Fresh California prunes are not canned commercially, but are perhaps preferable to dried prunes for home use. Select well colored ripe prunes of large size. Wash and place in cans. Add Medium syrup (40 per cent) hot. See table 1 for sterilization.

Cherries—Cherries canned without pitting develop a "bitter almond" or "pit" flavor, pleasing to some and disagreeable to others. Small hand-pitting machines can be obtained from any hardware store for a small price. (See fig. 8.) All pitting machines remove the pits by means of a cross-shaped plunger which laterates the flesh more or less, and, therefore, the fruit must be canned immediately after pitting to check deterioration. The Royal Anne, a large white cherry, is seldom pitted. Cherries tend to shrivel in heavy syrups or if covered with hot syrups. Only moderately sweet syrups should be used, therefore, and the cans exhausted by heating in boiling water or steam for 5 minutes before sealing, rather than exhausted after adding hot syrup. See table 1.

Blackberries.—Blackberries shrink during cooking and the fruit which fills a can when fresh will shrink to about two-thirds or less

after sterilizing. If the cans are to be well filled, the blackberries must first be cooked.

To each pound of fruit add one pound or less of sugar, according to the ripeness of the fruit. Boil with gentle stirring for about 3 to 4 minutes. Pack into cans or jars scalding hot. Seal cans. Sterilize cans at the boiling point for 5 minutes. Lacquered cans or glass jars must be used for all berries, because plain tin bleaches the color of the fruit. The extra syrup formed by the juice of the fruit can be used on the next lot or the excess moisture may be boiled off and the fruit made into a preserve before canning.

Fig. 8.—Small hand power cherry pitting machine for home use.

An alternative method is to cook with sugar, as directed, and store over night. Heat to boiling, and proceed as above.

Loganberries.—Loganberries may be canned by practically the same method as recommended for blackberries. Lacquered cans or glass jars must be used.

Raspberries.—Raspberries may be canned as directed for blackberries.

Strawberries.—These berries shrink very badly in volume if cooked in the can. Therefore, proceed as for blackberries after hulling.

Currants, Cranberries, Gooseberries.—These fruits are used only for pies, jellies, and jams, and are not commonly canned. They may be put up in enameled cans or in jars in plain water and sterilized at 212° F. No sugar need be used, although the flavor of the fruit is better if canned in syrup instead of water. See table 1.

Grapes.—Muscat grapes are canned commercially in considerable quantities in California. The thoroughly ripe grapes are removed from the stems and graded for size and appearance. Pack in cans or jars and add Medium or Light syrup. The canned fruit is used for pies. See also table 1.

Figs.—Figs are usually put in glass in the form of preserves. The fruit should be allowed to ripen thoroughly on the tree and must be handled carefully during picking and transferring to the cannery.

In commercial canning, figs are graded, washed and then blanched 3 to 4 minutes in hot water. They are then placed in the cans in a very heavy syrup (70° Balling) and are cooked in the sealed cans for about two hours at the boiling point. This method many be used in the home also.

For home use, the following method may be used: Grade the figs according to size. After cutting off the stems, the fruit is weighed and placed in a preserve kettle. For each pound of fruit, add 1 pound of sugar and 2 pints water. Boil down slowly until the hot syrup will test about 55–60° Balling or 33° Baumé, or until the mixture reaches a boiling point 8° above the boiling point of water, which is for most localities 220° F., or until the fruit is well cooked and of a consistency of a heavy preserve. Jars, with their caps and rubbers, are scalded by heating in boiling water. They are then filled with the boiling hot preserve and the caps screwed down loosely. As soon as filled the jars should be placed in hot water and sterilized at the boiling point for 25 to 30 minutes. Figs may be put up in cans in a similar manner. The Kadota, White Endich and other figs with few seeds and thick flesh are best suited to preserving, although the Mission, Calimyrna and White Adriatic may be used.

Rhubarb.—From a culinary point of view, rhubarb is a fruit and is very easily sterilized and canned in the same general way as fruits. Since it is used chiefly as a pie stock no sugar need be used.

Wash the stalks; cut into short lengths and place in a stewpan, with a little water. Boil until soft. Pack boiling hot into cans or jars and seal. See table 1 for sterilizing.

Tin cans are soon badly corroded by rhubarb and preferably only glass should be used.

1. *Preparation of the fruit.*—Wash, sort and prepare the fruit as for cooking. Remove peel, cores, and pits; cut or slice as desired. Cook as soon as possible after cutting. To prevent darkening, cut apples and pears should be kept in water until cooked.

2. *Heating and cooking with sugar.*—Place the prepared fruit in a pot and then add dry sugar, ¼ to ½ lb. per pound of fruit, or with very sweet fruit none. Add a little water to firm fruits to avoid scorching. Add no water to berries. Heat to scalding temperature. Do not cook till soft. Peaches, pears, cherries, grapes, and some other firm fruits may be canned without this preliminary cooking.

3. *Filling the jars.*—Warm the jars with hot water, and ladle the hot fruit into them through a funnel until they are filled to within ¼ inch of the top. Avoid getting juice on the outside. The neck should be dry and clean. Or pack uncooked firm fruits into jars cold. Add hot syrup and proceed as in steps 4–7.

Fig. 9.—Preparing fruits for modified hot pack process.

4. *Placing rubbers and covers.*—Test clean scalded, rubbers by bending and stretching. They should not crack. Put evenly in place on the necks of the jar, then apply the covers, placing or screwing them *loosely,* and lower the jars into the sterilizer, placing a piece of wire screening or other false bottom in the bottom of the boiler.

5. *Sterilizing in a wash boiler.*—Pour in a few inches of hot water around the jars. Apply the cover of the boiler. Unless the cover fits very well place a cloth beneath it. Heat until steam comes from beneath the cover and then for the time specified in table 1, page 36.

6. *Removal from the boiler.*—Remove immediately. Handles on the wire screen bottom or wire baskets to hold the jars facilitate removal. A cloth or a wire jar lifter may be used. The lifter in the illustration serves well for lifting jars and as a false bottom. Place hot jars on wood or paper to avoid cracking.

7. *Tightening the covers.*—Tighten the covers immediately and stand the jars upside down. This insures the sterilization of the covers. Leaky jars can be detected by air bubbles entering during cooling.

Fig. 10.—Sterilizing and sealing jars of fruit.

Grape Fruit (Pomelo).—Grape fruit is now canned in large quantities in Porto Rico and Florida and the industry is well established in California. Use only thoroughly ripened fruit. Peel. Separate the segments and peel these. Pack the peeled segments into jars or cans. Add a boiling hot syrup of 50° Balling. Grape fruit may also be canned in slices or cubes. See table 1 for sterilization.

Jelly Juices.—Boil jelly fruits as for jelly making. Thus, berries and currants are crushed, boiled 5 minutes and without addition of water; apples are sliced without previously peeling; enough water is added to prevent scorching and the fruit is boiled until soft, usually 15–20 minutes. Press the boiled fruits and strain the juice. Heat juice to boiling; pack into scalded jars and sterilize as directed in table 1. Cans are not recommended for jelly juices.

Crown capped bottles may be used instead of jars if desired. (See Circular 220.)

To use the jelly juice at a later date simply drain the juice carefully from the sediment in the jar—add the customary amount of sugar and boil until the jelling point is reached.

Ripe Olives.—*Two Lye Process.*—The Mission variety is best for home pickling, although the Manzanillo variety is also fairly satisfactory. The Sevillano and Ascolano varieties are very difficult to pickle and should not be used by those unfamiliar with the pickling of ripe olives.

Harvesting.—Pick the olives after they have acquired a light pink to red color and, if possible, before they have become jet black and over-ripe. Avoid bruising and prolonged storage in boxes before pickling.

Holding Solution.—If for any reason, it is necessary to ship the olives a great distance or to store them for a week or longer before pickling, cover them in suitable containers with a 5 per cent salt solution (about 4 pounds of salt per 10 gallons) for three or four days. Then cover them with a brine of about 12 per cent salt (about 9 pounds salt per 10 gallons of water) and keep the olives submerged in this solution until used. However, in home canning the olives will usually be pickled direct from the tree.

First Lye.—Prepare a lye solution of about 1¼ to 1½ per cent; this is approximately 1½ to 2 ounces of granulated lye per gallon of water, or approximately ½ to ¾ pound per 5 gallons of water. If the olives are tender use not more than 1 ounce of lye per gallon of water.

Cover the olives in a stoneware jar or wooden container with this lye solution. Stir every half hour and carefully observe the progress of the lye. The color of the skins will change as the lye penetrates the olives. Cut two or three olives lengthwise occasionally and when it is observed that the lye has penetrated through the skins of practically all of the olives and a short distance ($\frac{1}{64}$–$\frac{1}{32}$ inch) into the flesh of some of them, remove and discard the lye solution. With lye at 60–65° F. the time required is usually four to six hours. With tender skinned olives or at higher temperatures less time and with tough skinned olives and lower temperatures more time may be required.

First Exposure to Air.—Leave the olives in the jar or tub and stir three times daily to facilitate darkening of the color by oxidation. In order to avoid bruising, large tubs of olives may be filled with water at the time of stirring and the water drawn off after stirring. In small containers the fruit may be stirred with the hands without adding water.

Normally four to five days' exposure to air is required to give the desired color.

Second Lye.—The first lye treatment is to facilitate darkening of the color. The second is to remove bitterness.

Prepare a solution of one ounce of lye per gallon of water and place it on the olives. Stir them occasionally (about once an hour).

Cut two or three olives occasionally and carefully observe the lye action; it causes the flesh to darken slightly in color. Or obtain from the druggist a small bottle of *Phenolphthalein* solution. A drop of this solution applied to the cut surface will develop a red color to the depth of the lye penetration. If this solution is used, rinse the lye from the olive in water before cutting it for the test.

Leave olives in the lye solution until it completely reaches the pits of the fruit (usually 8–16 hours at 60–65° F.).

Water Treatment to Remove Lye.—When the lye has reached the pits of the olives remove and discard it. Cover the olives with water and leave them submerged in the water.

Change the water three times daily until all taste of lye is removed or until the cut surface will no longer cause the test solution (*Phenolphthalein*) to turn red or pink. Normally, seven days soaking in water is required.

Curing in Brine.—The olives at this stage are edible, but require salt to "bring out" their flavor. Store the olives for three days in a brine of about 4 ounces (¼ pound) of salt per gallon of water. They are then ready for serving or canning.

Canning and Sterilizing.—Pack into cans or jars. Add boiling hot brine of 4 ounces (¼ pound) of salt per gallon. Seal cans. Place scalded rubbers and caps on jars.

Sterilize as directed for vegetables in a pressure cooker at 240° F. for 40 minutes (10 pounds steam pressure).

THE STATE BOARD OF HEALTH HAS RULED THAT ALL OLIVES OFFERED FOR SALE MUST BE STERILIZED IN THIS MANNER.

One Lye Process.—The preceding process produces olives of dark color. If this color is not desired a lighter colored product of superior flavor may be prepared by a single treatment.

In using this process cover the olives with a lye solution of 2 per cent (2½ ounces of lye per gallon of water) and allow it to stand with occasional stirring until the lye penetrates completely to the pit; normally 12 to 24 hours.

Remove the lye. Cover the olives with water. Change the water three times daily until all taste of lye is removed (6–7 days).

Cure in brine, can and sterilize as directed for the two lye process.

D. SPECIAL DIRECTIONS FOR VEGETABLES

Most vegetables have only a small amount of acid as compared with fruits. This low degree of acidity, as we have seen, permits the growth of certain bacteria which are very difficult to kill by heating. Vegetables, therefore, are hard to sterilize. Tomatoes, which resemble fruit in respect to their acidity, are an exception.

Usually in sterilizing vegetables temperatures above 212° F. are necessary. This requires the use of tin cans and a steam-pressure cooker. Steam-pressure cookers are not difficult to operate and can be obtained at prices as low as $18.00.

Note.—Where a pressure sterilizer is not available, it is advised that vegetables be dehydrated. A leaflet describing the construction and operation of an inexpensive home size dehydrater for fruits and vegetables is obtainable free of charge from the College of Agriculture, Berkeley.

Artichokes.—Young artichokes only are used. The hard tip is trimmed off and some of the outer bracts removed, leaving only the tender parts.

They are blanched for 5 minutes in boiling water, acidified with ¾ measuring cup of lemon juice or vinegar per gallon, placed in cans or jars and covered with hot 2 per cent brine. For sterilization see table 2.

Asparagus.—Grade into large, medium, and small sizes. Cut into lengths to fit the container. This is conveniently done by making a small box, ¼ inch less than the depth of the can or jar and open at the top and one side. The bud ends of the stalks are placed in the box against the closed end and the butts protrude from the open end. They may be cut off flush with the edges of the open side of the box with a large sharp knife.

Blanch the stalks in boiling water for about 4 minutes. Pack into jars or cans with the tips up. Fill with hot brine and seal. Sterilize as directed in table 2.

Fig. 11.—Pressure sterilizer for home use. (Courtesy of the Henninger Ayes Co.)

Green Beans.—Green beans are best for canning when very young and tender, the larger and harder the pods and beans become, the lower their value for canning. Commercially, beans are usually put up in No. 2 cans.

Snip or string after sorting. The larger sizes should be cut into pieces about one and one-half inches long, while the small or No. 1 grade may be canned whole.

Blanch the No. 1 grade two minutes in boiling water and the larger grades for five minutes. Fill into cans hot.

Fill with hot brine and seal cans. Sterilize as directed in table 2.

Beets.—Beets should be small and turnip-shaped if canned for market. The first grade may be 1 to 1½ inches in diameter and the second over one and one-half inches. The large beets are quartered after peeling.

Scald in boiling water or in steam until the skin will slip easily, usually about fifteen minutes. Chill in cold water, peel, trim, and fill into enamel lined cans. Fill with hot brine and seal. Sterilize as directed in table 2.

Sweet Corn.—Only *young* tender ears of good varieties of sugar corn should be used. The corn must be fresh if good results are to be expected. The ears are husked, and the corn is cut from the cob. A syrup of ½ pound (one measuring cup) of sugar and 1½ ounces salt (4 level tablespoons) per gallon is made. The corn and a small amount of syrup (enough to cover the corn) are mixed and heated in a pot to boiling. The mixture is filled hot into cans, sealed and sterilized as directed in table 2. Cool the cans after sterilizing.

Peas.—Picking and hulling peas by hand is a very slow process and not to be recommended for commercial canning. Large canneries do the hulling, grading, blanching, and filling of cans entirely by machinery. It is feasible, however, to shell enough peas for canning by hand for home use. Use only fresh, tender peas.

Place the shelled peas in a wire basket or in a clean cloth and blanch in boiling water long enough to wringle the skin slightly. This will usually be about one to four minutes, depending upon the size and tenderness of the peas.

Fill into cans and fill with hot brine, consisting of 2 ounces (5 tablespoons) of salt and ½ measuring cup of sugar per gallon and seal cans. Sterilize as directed in table 2.

Peppers, Pimientos.—These vegetables are usually peeled by causing the skin to separate by roasting or by immersing in hot oil. They can be peeled successfully by immersing from two to three minutes in cottonseed oil heated to smoking. They are then chilled at once in cold water and the skins come off easily from the large peppers and pimientos. Small, pungent, tough-skinned Mexican peppers do not yield so well to this treament. When peeled in this way, the peppers are obtained soft and pliable and can be folded into the cans after removing stems and seed cores. The peppers or pimientos may also be peeled by roasting in a gas flame or in a very hot oven until the skin will separate.

Pack the peeled product into cans. Fill with boiling water or brine. Sterilize as directed in table 2.

Pumpkin.—Scrape out fibrous pulp and seeds and cut the flesh and rind into strips. Boil in water until soft. Scrape the flesh from the rind and press through a colander. Boil to desired consistency. Pack hot into cans and seal. Sterilize as directed in table 2.

Tomatoes.—Tomatoes have a considerable amount of acid which checks the growth of heat-resistant bacteria. They are, therefore, easily sterilized at 212° F. and jars may be used satisfactorily.

For canning purposes, the variety used should be smooth and of a deep red color. Corrugated tomatoes are too difficult to peel. The Stone is an excellent canning variety.

Sort the tomatoes and reject those which are spoiled and underripe. Place them in a blanching basket and immerse in boiling water long enough to crack and loosen the skin. This will usually be about one-half to one minute. Remove and chill in cold water. Slip off the skins and remove the cores. Pack the tomatoes tightly into jars or cans and fill with juice or heat to boiling in the juice obtained in coring and pack tightly into cans or jars hot and seal. If packed cold in cans, the filled cans should be heated in boiling water or live steam for five minutes before sealing. Sterilize as directed in table 1.

If the tomatoes are packed without the addition of juice, the product is known as "solid pack;" if juice is added, as "standard pack."

Tomatoes may be canned whole to be used for slicing for salads, although they will soften somewhat. Select small tomatoes that will go into the jars or cans. Cover with a hot tomato juice pressed from crushed fresh tomatoes. Seal. Sterilize as directed in table 1.

Tomato Puree and Hot Sauce.—Tomato puree or sauce is very convenient for flavoring many dishes, such as stews, soups and macaroni. Cook until soft. Rub through a fine screen to remove skins, seeds, and fiber. Concentrate the puree to about one-half its original volume by boiling. Pack boiling hot into cans or jars and seal cans. Sterilize as directed in table 1. If a hot sauce is desired, add salt, chopped onions, and hot peppers to taste to the tomatoes before cooking and screening.

Sweet Potatoes.—Wash. Boil until the skins will slip easily. Peel quickly and pack hot, filling the cans as tightly as possible. Seal. Sterilize as directed in table 2. After removal from sterilizer cans should be chilled at once in cold water.

Spinach and Other Greens.—Can as soon after picking as possible. Trim off stems and imperfect portions. Wash thoroughly to remove sand, etc. Blanch 3 to 5 minutes in steam rather than in water. Water dissolves valuable food material. Pack hot into cans. Fill with hot brine and seal. Sterilize as directed in table 2.

Okra (Gumbo).—This vegetable is grown frequently in the hot sections of the state for flavoring soups, stews, and other dishes. The pods resemble green peppers in appearance.

Use only the young, tender pods for canning. Remove stems. Blanch 6 to 8 minutes in boiling water. Pack into cans with boiling water. Sterilize as directed in table 2.

Concentrated Soup Mixtures.—Vegetables such as carrots, onions, tomatoes, beans, etc., may be prepared as for vegetable soup and canned. A recipe recommended by the United States Department of Agriculture is as follows:

"A good combination consists of 1 quart of screened concentrated tomato pulp (boiled tomatoes screened and two volumes of pulp boiled down to one volume), 1 pint of green corn or tiny Lima beans, 1 pint of okra or sweet peppers, 1 small onion chopped, ½ cup of chopped sweet red pepper, 1½ teaspoonfuls of salt, and 3 teaspoonfuls of sugar. Cook the tomatoes, pepper, and onion; put through a sieve to remove seeds; and cook down to about the consistency of ketchup. Measure, add the corn or beans and okra, which have been prepared as for canning. Add the seasoning and cook all together for 10 minutes. Pack at once into hot jars, and process as directed in table 2. Tin cans should be plunged immediately into cold water and cooled as quickly as possible. When cool, store in a dark, dry, cool place."

If all of the vegetables recommended are not available, others may be substituted, thus, cooked white beans for corn, pimientos for okra, white potatoes for Lima beans. Celery makes a valuable addition to the mixture. When used for soup the canned product is diluted with water and flavored with bouillon cubes or meat broth. For convenience it should be put up in small cans.

E. SPECIAL DIRECTIONS FOR MEATS

Meats, owing to their texture and absence of acidity are even more difficult to sterilize than vegetables. If incompletely sterilized, they may be attacked by certain heat-resistant bacteria which produce dangerous poisons. By carefully carrying out the directions given in this circular, however, there is no danger from this source.

For home canning, the meat should first be seasoned and partially cooked. For example, chicken or rabbit may be fried a short time before being placed in the cans and beef should be corned or cooked in some suitable way before canning.

The meat should be placed in the containers as hot as possible, as heat penetrates slowly during sterilization. The spaces between the pieces of meat should be filled with hot liquid, such as a suitable sauce. A hot, dilute gelatin solution is suitable, as it forms a stiff jelly between the pieces of meat. Any good brand of unflavored gelatine will do.

After filling and before sealing and sterilizing, cans should be exhausted in boiling water for 10 to 20 minutes before sealing. Jars should not be used.

Meat requires 40 to 80 minutes at 15 pounds steam pressure.

Canned Boiled Beef.—Remove the bones and rub the pieces of meat with a mixture of 5 parts of salt and 1 part of sugar. To improve the color a very small amount of saltpetre may be mixed with the salt. Repeat this rubbing 12 hours later. Tie the pieces together with twine and place in a pot, covering with salted water. Simmer for about two hours or until the meat is tender. Cooking before canning is necessary to prevent shrinkage in volume in the can. The flavor may be improved by placing a cotton bag containing a small quantity of mixed spices in the liquid while cooking. A suitable mixture is black pepper, 24 parts; bay leaves, 8 parts; mace, 6 parts; and nutmeg, 3 parts. A little vinegar may also be added.

When cooked, cut the meat into pieces of suitable size and fill the cans and cover with hot meat bouillon. This bouillon is made by boiling down the liquor in which the meat was cooked and adding a little gelatine previously dissolved in water. Seal cans and sterilize as directed in table 2.

Chicken and Rabbit.—Boil in lightly salted water until tender and remove the bones. Pass through a meat chopper if desired. Mix the prepared meat with a highly seasoned tomato sauce or with a white sauce made of flour, water, and spice; or other suitable sauce, and pack in cans or jars. Several ripe olives added to each can is an improvement.

Heat cans for 20 minutes in boiling water, seal, and sterilize as directed in table 2.

The meat may also be canned with the bones. It may be fried, roasted, or boiled, cut into pieces of suitable size, and packed in cans or jars in the liquid in which it is cooked, and sterilized as above.

It may also be placed in the cans raw and cooked and sterilized at the same time, but when prepared in this way, is inferior in flavor and appearance and shrinks greatly in volume.

Fish.—Small fish may be canned whole; large fish are cut into pieces of convenient size. Cooking and sterilizing take place in the can.

Large Fish.—After cleaning and cutting into pieces, the fish is improved if sprinkled with salt and allowed to stand and drain for a few hours. It is then washed, packed in cans, and covered with brine. It is then heated in the open cans in boiling water or steam for twenty minutes and the cans are sealed.

Small Fish.—The principal small fish canned is the sardine, though other small fish, such as small trout, may be canned in a similar way.

They may be canned in a tomato catsup or a mustard and vinegar sauce, flavored with spices. The heads of the fish are cut off, the scales removed if necessary, and the fish cleaned. They are then cooked in boiling water or steam, drained, and packed in cans. The hot sauce is then poured over them and the cans sealed and sterilized.

They may also be canned in olive, cottonseed, or peanut oil. They are, in this case, prepared as above, but are cooked in boiling oil instead of steam. They are then packed in cans with the oil, sealed and sterilized. Fish may be kippered before canning by smoking for two to three hours in smoke from oak sawdust. If to be kippered, the fish should be stored in brine (about ½ pound of salt per gallon) for 3–4 hours before smoking.

With tomato or vinegar sauces, heating for 40 minutes at 240° F. is sufficient for sterilization. In oil or a sauce that is not acid, they require heating to 250° F. or 15 pounds pressure for 75 minutes.

F. PTOMAIN AND BOTULINUS POISONING

If meat or vegetables are found after canning and storage to be partially decomposed or "soured," they may contain dangerous poisons.

Ptomains.—Poisonous ptomains rarely occur in canned food. They are produced by forms of protein-destroying bacteria, for example, by *Bacillus proteus vulgaris,* one of the commonest organisms of spoiled meat. The presence of ptomains is usually accompanied by a noticeable odor of decomposition. So far as is known, they do not frequently occur in canned fruits or vegetables. Ptomains are not destroyed by heating, so that badly spoiled meat is not rendered harmless by canning or cooking.

Botulinus Poisoning.—A more violent poison is produced by *Bacillus botulinus,* a microörganism which may grow in meats, vegetables and fruits low in acid. This bacteria sometimes grows in cans and jars of vegetables put up by the ordinary household method in which the food is not sterilized in the jar, and deaths have occurred from the use of such canned vegetables in the uncooked state. *It is very dangerous to can such vegetables as peas, beans, or corn, simply by cooking them until they are done and then sealing them in cans or jars without further sterilization.* The heat in this method is not sufficient to kill the spores of the *Bacillus botulinus* which may develop later and produce enough poison to be fatal.

The botulinus toxin is many times more poisonous than strychnine and is very hard to detect; the only outward evidence of its presence being a more or less rancid odor and gas pressure. The poison is, however, destroyed by heating to the *boiling* point for a reasonably long period (30 minutse). Therefore, if canned vegetables are thoroughly cooked after opening, there is little danger of botulinus poisoning.

The botulinus bacteria will not grow readily in acid substances, such as most fruits, rhubarb and tomatoes. The organism, however, may grow in rare cases in fruits of low acidity, such as pears and over-ripe apricots, etc.

Never Taste Spoiled Canned Food.—Suspicious jars or cans of food, that is, those which possess a disagreeable odor or show gas pressure, should be destroyed without tasting. The contents of such jars should be mixed with several spoonfuls of lye and jar and contents buried. Suspected material should be destroyed and not fed to chickens or animals. Many cases are on record in which valuable chickens have been killed by eating spoiled canned foods. Other cases of fatal poisoning have resulted from merely tasting spoiled cans of food.

If the methods recommended in this circular are carefully followed there will be no danger from botulinus poisoning.

Pressure Sterilization of Vegetables Necessary.—Vegetables, except rhubarb and tomatoes, must be sterilized under steam pressure as directed in table 2 in order to be safe. Do not attempt to sterilize such vegetables in boiling water or an open steam cooker only. *This circular supersedes Circular No. 158 and other publications in which sterilizing in boiling water may be found recommended. Disregard the directions in these older publications.*

G. CONDENSED DIRECTIONS

Tables 1 and 2 give brief directions for preparation and safe periods of sterilization for home canned products.

TABLE 1

CONDENSED DIRECTIONS FOR CANNING OF FRUITS, RHUBARB, AND TOMATOES

Variety	Preparation	Syrup * recommended	Minutes sterilization in boiling water or steam at 212° F.	
			Quart jars	Quart cans
Apples	Peel, core, quarter, blanch 3–4 min.	Water	15	12
Apricots	Halve and pit; blanch in medium syrup 3–4 min.	Medium or heavy; 40 or 60° Bal.	25	15
Berries, all varieties	Boil 3 min. with equal weight of sugar, stand 24 hours, pack hot.	In own syrup	15	10
Cherries, sweet	Stem; pit if desired	Medium or light; 40 or 20° Bal.	30	20
Cherries, sour for pie	Stem and pit	Water	30	20
Figs (preserved)	Equal parts sugar, fruit, and water cooked to preserves; can hot.	In own syrup	30	25
Figs in syrup	Sort and wash	Very heavy; 70–75° Bal.	120	120
Grapes, Muscat	Stem	Medium or light; 40 or 20° Bal.	20	15
Peaches, cling	Halves, pit and peel	Medium or heavy; 40 or 60° Bal.	35	30
Peaches, free	Halves, pit and peel	do	25	20
Pears	Peel, halve, and core	Medium or light; 40 or 20° Bal.	30	25
Plums	Sort, stem, and wash	Heavy or medium; 60 or 40° Bal.	20	10
Prunes, fresh	Halves, pit and peel	Medium; 40° Bal.	30	20
Rhubarb	Wash, cut, and stew until soft; pack hot; no sugar.	In own juice	15	10
Tomatoes	Scald, cold, dip, peel, and core.	In own juice	45	35
Tomato puree	Boil soft, screen, boil to ½ volume and can hot.	In own juice	20	15
Jelly juices	Boil fruit; press and strain juice as for jelly making; can hot.	In own juice	15	10
Fruit juices	(See Circular 220)			

* Syrups: For convenience, syrups are classified as: Light, 1 cup of sugar to 4 of water; Medium, 1 cup of sugar to 2 of water, and heavy, 1½ cups of sugar to 1 of water.

TABLE 2

CONDENSED DIRECTIONS FOR VEGETABLES, OLIVES, AND MEATS

For brines see special directions for each product. Use only cans for products listed in this table.

Variety	Preparation	Minutes sterilization	
		At 10 lbs. pressure	At 15 lbs. pressure
Artichokes	Blanch 5 minutes in water with ¾ cup vinegar per gal.	30	20
Asparagus	Sort, cut, blanch 3–6 minutes	30	20
String beans	Snip, cut, and blanch 2–10 minutes	30	.....
Beets	Parboil, peal, and cut	30	.....
Corn	Cut from cob. See page 30	150	80
Greens and spinach	Trim, wash, blanch 5 minutes	65	60
Olives, ripe	Pickle as directed on page 26	40	.....
Okra ("gumbo")	Cut; blanch 6–8 minutes	40	.....
Pimientos and peppers	Roast in flame or oven or heat in hot oil; chill; peel and core.	50	.....
Pumpkin and squash	Cut; remove seeds and "rag"; cook; scrape from skin; pack without brine.	120	90
Sweet potatoes	Cook; peel; pack solid without brine	90	75
Vegetable soup mixture	See special directions, page 32	50	.....
Meats and fish	Cook, pack in liquid from cooking, heat in steam 20 minutes; seal.	120	75

Effect of Altitude.—The times given in Table 1 for sterilizing in boiling water are designed for altitudes from sea level to 1,000 feet. For altitudes above 1,000 feet the length of sterilization in boiling water should be increased about 20 per cent (one-fifth) for each additional one thousand feet. Thus at 2,000 feet a sterilizing time of 60 minutes in boiling water would become 60 plus 12, or 72 minutes.

Sterilization under pressure is also affected by altitude; therefore, the pressure should be increased 1 pound for each 2,000 feet increase in elevation. The pressures and times in the table apply from sea level to about 2,000 feet.

STATION PUBLICATIONS AVAILABLE FOR FREE DISTRIBUTION

BULLETINS

No.

253. Irrigation and Soil Conditions in the Sierra Nevada Foothills, California.
261. Melaxuma of the Walnut, "Juglans regia."
262. Citrus Diseases of Florida and Cuba Compared with those of California.
263. Size Grades for Ripe Olives.
268. Growing and Grafting Olive Seedlings.
273. Preliminary Report on Kearney Vineyard Experimental Drain.
275. The Cultivation of Belladonna in California.
276. The Pomegranate.
277. Sudan Grass.
278. Grain Sorghums.
279. Irrigation of Rice in California.
280. Irrigation of Alfalfa in the Sacramento Valley.
283. The Olive Insects of California.
285. The Milk Goat in California.
286. Commercial Fertilizers.
287. Vinegar from Waste Fruits.
294. Bean Culture in California.
298. Seedless Raisin Grapes.
304. A Study of the Effects of Freezes on Citrus in California.
312. Mariout Barley.
317. Selections of Stocks in Citrus Propagation.
319. Caprifigs and Caprification.
321. Commercial Production of Grape Syrup.
324. Storage of Perishable Fruit at Freezing Temperatures.
325. Rice Irrigation Measurements and Experiments in Sacramento Valley, 1914–1919.
328. Prune Growing in California.
331. Phylloxera-Resistant Stocks.
334. Preliminary Volume Tables for Second-Growth Redwood.
335. Cocoanut Meal as a Feed for Dairy Cows and Other Livestock.
336. The Preparation of Nicotine Dust as an Insecticide.
339. The Relative Cost of Making Logs from Small and Large Timber.
343. Cheese Pests and Their Control.
344. Cold Storage as an Aid to the Marketing of Plums.

No.

346. Almond Pollination.
347. The Control of Red Spiders in Deciduous Orchards.
348. Pruning Young Olive Trees.
349. A Study of Sidedraft and Tractor Hitches.
350. Agriculture in Cut-over Redwood Lands.
351. California State Dairy Cow Competition.
352. Further Experiments in Plum Pollination.
353. Bovine Infectious Abortion.
354. Results of Rice Experiments in 1922.
355. The Peach Twig Borer.
357. A Self-mixing Dusting Machine for Applying Dry Insecticides and Fungicides.
358. Black Measles, Water Berries, and Related Vine Troubles.
359. Fruit Beverage Investigations.
360. Gum Diseases of Citrus Trees in California.
361. Preliminary Yield Tables for Second Growth Redwood.
362. Dust and the Tractor Engine.
363. The Pruning of Citrus Trees in California.
364. Fungicidal Dusts for the Control of Bunt.
366. Turkish Tobacco Culture, Curing and Marketing.
367. Methods of Harvesting and Irrigation in Relation to Mouldy Walnuts.
368. Bacterial Decomposition of Olives during Pickling.
369. Comparison of Woods for Butter Boxes.
370. Browning of Yellow Newtown Apples.
371. The Relative Cost of Yarding Small and Large Timber.
372. The Cost of Producing Market Milk and Butterfat on 246 California Dairies.
373. Pear Pollination.
374. A Survey of Orchard Practices in the Citrus Industry of Southern California.
375. Results of Rice Experiments at Cortena, 1923.
376. Sun-Drying and Dehydration of Walnuts.

CIRCULARS

No.

70. Observations on the Status of Corn Growing in California.
87. Alfalfa.
111. The Use of Lime and Gypsum on California Soils.
113. Correspondence Courses in Agriculture.
117. The Selection and Cost of a Small Pumping Plant.
127. House Fumigation.
129. The Control of Citrus Insects.
136. *Melilotus indica* as a Green-Manure Crop for California.
144. Oidium or Powdery Mildew of the Vine.
151. Feeding and Management of Hogs.
152. Some Observations on the Bulk Handling of Grain in California.
153. Announcement of the California State Dairy Cow Competition, 1916–18.
154. Irrigation Practice in Growing Small Fruit in California.
155. Bovine Tuberculosis.
157. Control of the Pear Scab.
158. Home and Farm Canning.
160. Lettuce Growing in California.

No.

161. Potatoes in California.
164. Small Fruit Culture in California.
165. Fundamentals of Sugar Beet Culture under California Conditions.
166. The County Farm Bureau.
167. Feeding Stuffs of Minor Importance.
170. Fertilizing California Soils for the 1918 Crop.
172. Wheat Culture.
173. The Construction of the Wood-Hoop Silo.
174. Farm Drainage Methods.
178. The Packing of Apples in California.
179. Factors of Importance in Producing Milk of Low Bacterial Count.
184. A Flock of Sheep on the Farm.
190. Agriculture Clubs in California.
193. A Study of Farm Labor in California.
198. Syrup from Sweet Sorghum.
199. Onion Growing in California.
201. Helpful Hints to Hog Raisers.
202. County Organizations for Rural Fire Control.
203. Peat as a Manure Substitute.

No.

205. Blackleg.
206. Jack Cheese.
208. Summary of the Annual Reports of the Farm Advisors of California.
209. The Function of the Farm Bureau.
210. Suggestions to the Settler in California.
212. Salvaging Rain-Damaged Prunes.
214. Seed Treatment for the Prevention of Cereal Smuts.
215. Feeding Dairy Cows in California.
217. Methods for Marketing Vegetables in California.
219. The Present Status of Alkali.
220. Unfermented Fruit Juices.
228. Vineyard Irrigation in Arid Climates.
230. Testing Milk, Cream, and Skim Milk for Butterfat.
231. The Home Vineyard.
232. Harvesting and Handling California Cherries for Eastern Shipment.
233. Artificial Incubation.
234. Winter Injury to Young Walnut Trees during 1921–22.
235. Soil Analysis and Soil and Plant Interrelations.
236. The Common Hawks and Owls of California from the Standpoint of the Rancher.
237. Directions for the Tanning and Dressing of Furs.
238. The Apricot in California.
239. Harvesting and Handling Apricots and Plums for Eastern Shipment.
240. Harvesting and Handling Pears for Eastern Shipment.
241. Harvesting and Handling Peaches for Eastern Shipment.
243. Marmalade Juice and Jelly Juice from Citrus Fruits.
244. Central Wire Bracing for Fruit Trees.
245. Vine Pruning Systems.

No.

247. Colonization and Rural Development.
248. Some Common Errors in Vine Pruning and Their Remedies.
249. Replacing Missing Vines.
250. Measurement of Irrigation Water on the Farm.
251. Recommendations Concerning the Common Diseases and Parasites of Poultry in California.
252. Supports for Vines.
253. Vineyard Plans.
254. The Use of Artificial Light to Increase Winter Egg Production.
255. Leguminous Plants as Organic Fertilizer in California Agriculture.
256. The Control of Wild Morning Glory.
257. The Small-Seeded Horse Bean.
258. Thinning Deciduous Fruits.
259. Pear By-products.
260. A Selected List of References Relating to Irrigation in California.
261. Sewing Grain Sacks.
262. Cabbage Growing in California.
263. Tomato Production in California.
264. Preliminary Essentials to Bovine Tuberculosis Control.
265. Plant Disease and Pest Control.
266. Analyzing the Citrus Orchard by Means of Simple Tree Records.
267. The Tendency of Tractors to Rise in Front; Causes and Remedies.
268. Inexpensive Labor-saving Poultry Appliances.
269. An Orchard Brush Burner.
270. A Farm Septic Tank.
271. Brooding Chicks Artificially.
272. California Farm Tenancy and Methods of Leasing.
273. Saving the Gophered Citrus Tree.
275. Marketable California Decorative Greens.